Underwater Image Enhancement Using a Multiscale Dense Generative Adversarial Network

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Abstract

Underwater image enhancement has received much attention in underwater vision research. However, raw underwater images easily suffer from color distortion, underexposure, and fuzz caused by the underwater scene. To address the above-mentioned problems, we propose a new multiscale dense generative adversarial network (GAN) for enhancing underwater images. The residual multiscale dense block is presented in the generator, where the multiscale, dense concatenation, and residual learning can boost the performance, render more details, and utilize previous features, respectively. And the discriminator employs computationally light spectral normalization to stabilize the training of the discriminator. Meanwhile, nonsaturating GAN loss function combining L_1 loss and gradient loss is presented to focus on image features of ground truth. Final enhanced results on synthetic and real underwater images demonstrate the superiority of the proposed method, which outperforms nondeep and deep learning methods in both qualitative and quantitative evaluations. Furthermore, we perform an ablation study to show the contributions of each component and carry out application tests to further demonstrate the effectiveness of the proposed method.